Assessment of Basic Knowledge About Alzheimer's Disease Among Older Rural Residents: A Pilot Test of a New Measure

Lisa Kirk Wiese, PhD, RN, APHN-BC, CNE
Christine L. Williams, DNSc, PMHCNS-BC
Ruth Tappen, EdD, RN, FAAN
David Newman, PhD, MA, MS
Monica Rosselli, PhD

Florida Atlantic University, Boca Raton, FL

Background and Purpose: Underserved rural populations face a higher risk of Alzheimer's disease (AD), yet studies investigating AD knowledge in this population are lacking. The purpose of this research was to develop an AD basic knowledge measure that is appropriate for use with underserved populations. Method: A content domain map, content validity index, and cognitive interviews were used in developing the first version of the basic knowledge of Alzheimer's disease (BKAD; Study 1). Reliability and validity of the measure in this descriptive study were examined using Rasch modeling and tests for construct, concurrent, and discriminate validity (Study 2). Multiple regression was employed to examine AD knowledge predictors. Results: Findings included that the BKAD instrument discriminated well between persons with varied education levels. Psychometric analysis yielded important information to guide revision of the BKAD measure. Conclusion: The BKAD measure shows promise in meeting the need for a culturally relevant measure to assess basic Alzheimer's disease knowledge in underserved rural populations.

Keywords: rural; older adult; underserved; basic knowledge of Alzheimer's disease; reliability and validity testing; Appalachian

Every 66 seconds, someone in the United States develops Alzheimer's disease (AD). More persons are diagnosed with AD than breast and prostate cancer combined. One in 3 seniors dies with AD or another form of dementia. Estimated 2016 AD care costs were $259 billion and projected to bankrupt the nation at more than $1 trillion by 2050 (Alzheimer's Association [AA], 2017a).

Persons living in rural areas face heightened risk of cognitive impairment (Russ, Batty, Hearnshaw, Fenton, & Starr, 2012) because of health care barriers including adverse social determinants of health, insufficient knowledge about brain health, and difficulty in navigating the health care system (Galvin, Fu, Nguyen, Glasheen, & Scharff, 2009; Wiese, Williams, & Tappen, 2014). People who live in rural counties with poorer health such as Appalachia are also the most economically distressed and the least educated and have the most limited

access to social and health services (Borak, Salipante-Zaidel, Slade, & Fields, 2012). Although research regarding knowledge, beliefs, and practices related to diabetes (Colliver, 2016; Della, King, & Ha, 2013; Johnson, & Denham, 2015; Record et al., 2017) and cancer (Baltic et al., 2015; Davis, Buchanan, & Green, 2013; Ramirez et al., 2015; Shinault, 2016; Tan et al., 2016; Vanderpool, Huang, & Shelton, 2012) in this population exists, there are no equivalent studies addressing AD. Review of research concerning other progressive diseases in rural Appalachian populations showed that if people are aware of or knowledgeable about risk for a chronic illness, they will be more willing to adopt healthy behaviors (Crosby, Vanderpool, & Jones, 2016; Della, 2011; Hatcher, Studts, Dignan, Turner, & Schoenberg, 2011; Schoenberg, Bardach, Manchikati, & Goodenow, 2011; VanDyke & Shell, 2016). An initial step in designing culturally relevant interventions to improve health is to assess educational needs using an appropriate assessment measure, yet none were found in the literature review conducted by the authors.

The purpose of this research is to develop an AD basic knowledge measure that is socially and educationally sensitive and appropriate for use with rural, underserved populations. The objectives being tested in a sample of rural older adults were (a) estimate the reliability and validity of a new instrument to assess basic knowledge about AD and (b) describe knowledge levels about AD symptoms, risk, detection, treatment, and prevention. The intended audience of this article is health care providers who are seeking to increase awareness of the need for early AD screening, detection, and treatment rates in rural, underserved communities.

BACKGROUND

The United States Census Bureau (2010) defines *rural* as all territory in population centers of less than 50,000. Rural cultures are considered to be an ethnic subgroup, according to Long and Weinert (1989) with subcultural norms of knowledge, values, and beliefs that influence their views on health and choices about where and from whom they seek care and advice. Others have noted the importance of including culture in research addressing underserved populations (Tappen, Gibson, & Williams, 2011) and that willingness to be screened varies across cultures (Kelly, Ferketich, Ruffin, Tatum, & Paskett, 2012; Williams, Tappen, Rosselli, Keane, & Newlin, 2010).

A RURAL EXEMPLAR

This study was conducted in West Virginia (WV) where 38% of its residents live in rural areas (Rural Assistance Center, 2012). WV has the second highest percentage of older adults in the country after Florida (United States Census Bureau, 2010). The geographic isolation associated with the rural areas of Appalachia adds to the traditional risk factors in rapidly aging rural populations, such as lack of health care access, poorer health, high unemployment rates, lower per capita income, and lack of health insurance (McGarvey, Leon-Verdin, Killos, Guterbock, & Cohn, 2011). Blackley, Behringer, and Zheng (2012) found that compounding factors from residing in Appalachia worsen the impact of rurality, such as living and working in the mountains near chemical factories and pesticides in agriculture and exposure to toxins such as coal and lime dust, which predispose rural residents to chronic diseases such as cancer and asthma.

Acknowledging that Appalachian residents are a distinct rural group, Goins, Spencer, and Williams (2011) investigated 101 rural Appalachian adults in six different rural counties to identify how residents defined health. Using 13 focus groups, self-administered

short surveys, and systematic text analysis of the results, they discovered that Appalachian older adults' perceptions about health contain components that many providers would not consider when planning care. For example, research participants indicated that a strong religious life and gratitude for God's grace were an integral aspect of their definition of health and that having both a sense of purpose and no worries were important components of well-being. The researchers recommended including a "more contextually sensitive recognition of rural elders' desired health goals and outcomes" (Goins et al., 2011, p. 13) within the traditional medical approach.

Residents of WV include a growing population of older adults who often suffer from comorbidities such as diabetes that predispose to AD. The characteristics of rural Appalachia such as mountainous terrain that limits health access and exposure to toxins combine to heighten vulnerability. Appalachians also share characteristics with other rural populations such as low income, education, and health literacy. Taken together, these factors are significant barriers to improving their health outcomes. Determining gaps in knowledge about the age-related chronic disease of Alzheimer's disease with a measure that is appropriate to rural populations such as Appalachia, could lead to programs to educate the public, earlier detection of AD, and eventually better cognitive health.

THEORETICAL FRAMEWORK

Arthur Kleinman (Kleinman, 1987; Kleinman, Eisenberg, & Good, 1978) noted the importance of assessing individual and community attitudes, beliefs, and knowledge about an illness when conducting research. He emphasized that health problems are framed by the patient's "local world" that includes persons' neighborhoods, networks, family, and friends (Kleinman, 2006, pp. 358–377) and charged that health concerns need to be viewed as cultural in context. Kleinman's (1988) approach to discovering how persons view their illness was applied as an approach to discovering what persons know about an illness. Kleinman's (1988) original "eight questions" were adopted as a guide when constructing items for an instrument to examine beliefs and knowledge about AD. For example, the influence of Kleinman's (1988) first question "What do you think caused your illness?" is seen in the basic knowledge of Alzheimer's disease (BKAD) Items 1 and 15, respectively: "AD is a normal part of aging" and "Alzheimer's disease is a type of dementia." A summary of the BKAD test item construction guided by Kleinman's (1988) work is available in Table 1.

PREVIOUS ALZHEIMER'S DISEASE KNOWLEDGE TESTS

Seven early measures of AD knowledge (Ayalon & Areán, 2004; Blay, Furtado, & Peluso, 2008; Connell, Roberts, & McLaughlin, 2005; Roberts & Connell, 2000; Roberts et al., 2003; Steckenrider, 1993; Werner & Heinik, 2004) are obsolete because they were based on information that is now outdated regarding AD, targeted only caregivers, or were tested in urban settings with individuals having a higher income base. Two more recent measures (Carpenter, Balsis, Otilingam, Hanson, & Gatz, 2009; Jang, Kim, & Chiriboga, 2010) were designed and tested for use with persons at a higher level of education. The most widely used measure, the Alzheimer's Disease Knowledge Scale (ADKS; Carpenter et al., 2009), had an average grade level of 11.5 among five different readability tests: the Flesh–Kincaid, 10.2; SMOG Index, 10.7; Gunning Fog Score, 10.4;

TABLE 1. Application of Kleinman's (1988) Explanatory Illness Model: Eight Questions to Basic Knowledge of Alzheimer's Disease Test Development

Kleinman's Question (1988)	Basic Knowledge of Alzheimer's Disease Test Items
1. What do you think has caused your problem?	1. Alzheimer's disease is a normal part of aging. 15. Alzheimer's disease is a type of dementia.
2. Why do you think it started when it did?	4. There is nothing that can be done to decrease the chances of getting Alzheimer's disease. 7. The chance of getting Alzheimer's disease is greater if a parent had it.
3. What do you think your problem does inside your body?	3. People with Alzheimer's disease are not crazy. 12. Persons with Alzheimer's disease may not understand what is being said to them. 16. All persons with Alzheimer's disease will eventually go through a violent stage. 17. Persons with Alzheimer's disease eventually change so much that nothing is left of the person they once were.
4. How severe is your problem? Will it have a short or long course?	2. Staying active might help to prevent Alzheimer's disease. 11. Finding out earlier you have Alzheimer's disease may help you by starting treatment earlier.
5. What kind of treatment do you think you should receive?	5. There is medicine that may slow down Alzheimer's disease. 18. If you have problems with your memory, you should be seen by a health care provider. 19. There are no herbs that will improve your memory. 20. Doctors recommend that people over 65 should get their memory checked every year.
6. What are the most important results you hope to receive from this treatment?	11. Early detection of Alzheimer's disease means there is a chance for earlier treatment.
7. What are the chief problems your illness has caused you?	6. Persons with Alzheimer's disease find it harder to remember things. 8. People who have Alzheimer's disease may become lost in familiar places. 9. Persons with Alzheimer's disease may accuse others of stealing missing items. 10. Losing the car keys does NOT mean that the person is getting Alzheimer's disease. 13. Persons in the later stages of Alzheimer's disease may take things that don't belong to them. 14. Persons with Alzheimer's disease may forget words when talking.
8. What do you fear most about your illness/treatment?	This question was not addressed in the BKAD, and is an implication for future qualitative research.

Note. BKAD = basic knowledge of Alzheimer's disease.

Coleman–Liau Index, 15.2; and Automated Readability Index, 10.7. Carpenter and colleagues (2009) noted the need for an instrument designed at an eighth-grade level or lower. The Knowledge of Alzheimer's Disease (KAD scale; Jang et al. 2010), which was used for concurrent validity, had similar results with an average of grade level of 11.7. For this reason, these measures were not viewed as acceptable for use in a population in which 33% of the state was reported as being below the national average for eighth-grade reading level (National Center for Education Statistics, n.d.). The lowest reading levels were found in the southern coalfield areas below the Kanawha River, near where the area of research was conducted.

Existing AD knowledge measures have limited generalizability to a rural population such as Appalachia. The currently available tools were designed for students, health care professionals, and caregivers, or they have been validated among persons of higher socioeconomic and educational backgrounds than many lay rural residents who typically have lower levels of literacy. A measure of basic AD knowledge that is appropriate for underserved populations was lacking.

DEVELOPING A BASIC KNOWLEDGE OF ALZHEIMER'S DISEASE INSTRUMENT

To fill this gap, the BKAD instrument was developed. Polit and Yang (2016) offer a helpful outline for designing new measures in their Table 4.1 (p. 50). The first steps involve the initial construction of the instrument, which include elaborating on the construct; developing the item pool; assessing readability and refining items; pretesting the items including cognitive interviews; and revising, adding, and deleting items based on the pretest and content and face validity. The remaining steps involve testing and statistical analysis to obtain preliminary estimates of scale quality by employing reliability and validity testing and factor analysis. Results from the development of the BKAD as recommended by Polit and Yang (2016) are provided in the following text.

Overview of the Basic Knowledge of Alzheimer's Disease Development Process

The BKAD test developed through a year-long process. These included investigating the state of the science regarding AD with expert nurse and physician gerontologists, discussions with the WV Alzheimer's Association (WVAA) administration and staff, interviewing two clinic managers and a nurse practitioner from two Fayette County health clinics of the WV New River Health Association, and reviewing both lay and professional information available from the AA. Five domains of AD knowledge were identified in collaboration with two PhD-educated geriatric nurse researchers (CW and RT): symptoms, risk, detection, treatment, and prevention. The content domain map is available in Table 2.

Content Validity Index. Two Appalachian lay leaders and two nurse experts each independently completed a content validity index (CVI; Waltz, Strickland, & Lenz, 2010). One lay leader was the current WVAA director and had worked in rural populations for the AA for more than 20 years, primarily in WV. The second lay leader was the director of community outreach for the WV Rural Health Education Centers and had resided in WV since birth. The PhD researchers, each with more than 20 years of experience

among older, underserved, and persons with dementia populations, comprised the nurse experts. All CVI reviewers were instructed in the use of the CVI. The scale categories for each BKAD item were *relevant*, *stated appropriately for the population*, *not relevant*, and *not stated appropriately for the population*. Each reviewer ranked items in terms of clarity and relevance using a 3-point scale of 0 (*do not agree*), 1 (*somewhat agree*), and 2 (*completely agree*).

The CVI results were analyzed using Cohen's kappa (κ) statistic (Landis & Koch, 1977) and Light's (1971) approach as cited in Polit and Yang (2016) to measure rater proportion of agreement as a means of multi-rater reliability for each test item (Polit & Yang, 2016). Polit and Yang offer a detailed description of calculating multi-rater reliability (Polit & Yang, 2016, pp. 125–129). They emphasize that Cohen's intent was that even without prior views, agreement between raters would occur with an expected frequency based on chance. The required assumptions for this statistic were met in this study; people being rated were independent of one another, the same *k* raters made the ratings, and the rating categories were independent of one another (Polit & Yang, 2016, p. 126). Light's (1971) method of calculating the rater groups and then computing the mean was used. Substantial agreement was found between the CVI reviewers according to Landis and Koch (1977) with the κ = .69 (*p* < .001), where a kappa of .41–.60 is considerate moderate, .61–.80 is substantial, and .81 or greater is outstanding. A comments section provided space for reviewers to add additional written feedback for the scale overall regarding if the measure sufficiently addressed the five AD knowledge domains of symptoms, risk, detection, treatment, and prevention.

Edits to the BKAD as a result of the CVI largely focused on changing wordings of items that the WV residents felt were more relevant or acceptable. For example, for the item "Persons with AD eventually are unable to recognize friends," both of the WV reviewers commented that this should also include family members, so the item was changed to "Persons with AD will become unable to recognize friends or family members." A lay WV reviewer commented on the item "Persons with AD are insane." stating that "people here say 'crazy,' not 'insane.'" A summary of the CVI is available in Table 3.

Cognitive Interviewing. Polit and Yang (2016) recommend cognitive interviewing as a means to understanding participants' thought process in their responses during instrument development (p. 42). The "think aloud" (Haeger, Lambert, Kinzie, & Gieser, 2012; Lundgrén-Laine & Salanterä, 2010) technique of qualitative exploration was used with the first 5 of 20 participants during an initial trial (Study 1) to obtain feedback regarding the relatability of test questions. The purpose of this approach was to elicit participant responses as a descriptive qualitative inquiry to assess validity of selected items on the knowledge test (Fonteyn, Kuipers, & Grobe, 1993; Lundgrén-Laine & Salanterä, 2010). After subjects completed the BKAD test, the researcher asked the participant to verbalize his or her thoughts regarding "why" the question was answered in the manner it was (Redline, Smiley, Lee, & DeMaio, 1998). Lundgrén-Laine and Salanterä (2010) point out that the benefit of the think-aloud technique compared to other methods of inquiry is that it "links the thinking processes of the participant with concurrent perceptions, thus revealing information available on the working memory" (p. 567).

Insights gained from the participant statements during the think-aloud exercise were considered when examining items for retention. For example, 75% of subjects shared that a mother, father, or sister had suffered with AD. This supported retaining the BKAD item "The chance of getting AD is higher if a parent had it." Fifty percent of participants mentioned that AD was expected as one grew older; therefore, the item "AD is a normal

TABLE 2. Content Domain Map for the Basic Knowledge of Alzheimer's Disease Instrument

Test Item	Concept Category	Source: Tappen et al. (2011) Article	Source: AA "Ten Warning Signs of AD"	Source: Prior AD Knowledge Tool	Source: Newly Authored or Edited by CVI Contributor	Source: Current Literature
1. AD is a normal part of aging (F).	Risk	X	X	X	—	
2. Staying active might help to prevent AD.	Prevention				X	X
3. PWAD are not crazy.	Symptom	X		X	X	
4. Nothing can be done to decrease the chances of getting AD (F).	Risk	X		X	X	X
5. There is medicine that may slow down AD.	Treatment			X	X	X
6. PWAD find it harder to remember things.	Symptom	X	X	X	X	
7. The chance of getting AD is greater if a parent had it.	Risk			X		X
8. People who have AD may become lost in familiar places.	Symptom	X	X		X	
9. Persons with AD may accuse others of stealing missing items	Symptom	X			X	
10. Losing the car keys does NOT mean that the person is getting AD.	Symptom	X			X	
11. Finding out earlier that you have AD may help you by starting treatment earlier.	Detection				X	X
12. Persons with AD may not understand what is being said to them	Symptom	X	X		X	
13. Persons in the later stages of AD may take things that don't belong to them.	Symptom		X		X	
14. PWAD may forget words when talking.	Symptom		X		X	
15. AD is a type of dementia.	Symptom			X		

(Continued)

TABLE 2. Content Domain Map for the Basic Knowledge of Alzheimer's Disease Instrument *(Continued)*

Test Item	Concept Category	Source: Tappen et al. (2011) Article	Source: AA "Ten Warning Signs of AD"	Source: Prior AD Knowledge Tool	Source: Newly Authored or Edited by CVI Contributor	Source: Current Literature
16. All persons with AD will eventually go through a violent stage (F).	Symptom	X	X		X	
17. PWAD eventually change so much that nothing is left of the person they once were (F).	Symptom				X	
18. If you have problems with your memory, you should be seen by a health care provider.	Detection				X	X
19. There are no herbs that will improve your memory.	Treatment				X	
20. Doctors recommend that people over 65 should get their memory checked every year.	Detection				X	X

Theoretical Concept Grounding Test Item	Total Number of Test Items	Source: Tappen et al. (2011) Article	Source: AA "Ten Warning Signs of AD"	Source: Prior AD Knowledge Tools	Source: Current Literature (New/Updated Information Published Within Last 5 Years)	Source: Edited or Authored by CVI Contributor
Risk	3	2	1	3	2	3
Symptoms	11	7	6	2	—	9
Treatment	2	—	—	1	2	3
Detection	3	—	—	—	3	3
Prevention	1	2	—	1	—	—
Sources Total	20	11	7	7	7	18

Note. AA = Alzheimer's Association; AD = Alzheimer's Disease; CVI = content validity index; F = False; PWAD = person with Alzheimer's Disease.

TABLE 3. Summary of Basic Knowledge of Alzheimer's Disease Survey Edits Following a Content Validity Index

Survey Question	Recommended Change or Addition	Revision
1. AD is a normal part of growing older.	Restate to say "Memory loss or forgetting things is a normal part of aging." (Nurse Experts)	Memory loss is a normal part of aging.
4. Persons with AD eventually are unable to recognize friends.	"I would restate this to include family members." (Lay Leaders)	Persons with Alzheimer's disease will become unable to recognize friends or family members.
5. Taking medicine will help to prevent AD.	"Not true the way it is stated." (Lay Leader) Additional suggestions: "There is medicine that may keep Alzheimer's disease from getting worse." (Lay Leader) "Taking the right medicine prevents Alzheimer's disease." (as a false statement; Nurse Expert)	Additional suggestions added.
7. People with AD are insane.	People here say "crazy." (Lay Leader) Better yet, say "AD is a mental illness." (Nurse Experts)	"People with AD are crazy." After the first think aloud, the verbiage was changed to the second suggestion as the researcher observed participants making faces with the use of the word *crazy* as if that was also offensive.
10. Losing the car keys often means that a person has AD.	Change to "Losing the car keys does NOT mean that a person is getting AD." (Lay Leader)	Not accepted (wording confusing)
13. Persons with AD have extreme mood changes.	"Perhaps rephrase." (Lay Leader) Additional suggestions: "Persons with Alzheimer's disease do not have the same emotions as other adults." (Lay Leader) "People with Alzheimer's disease always go through a violent stage." (Nurse Experts)	The second suggestion was added.

(Continued)

TABLE 3. Summary of Basic Knowledge of Alzheimer's Disease Survey Edits Following a Content Validity Index *(Continued)*

Survey Question	Recommended Change or Addition	Revision
15. Persons with AD might take things that they think are theirs.	"Persons with Alzheimer's disease might take things that don't belong to them." (Nurse Experts)	Accepted
18. Persons with AD get lost even in familiar places	Restate to change "wander about." (Lay Leader)	No change
23. Persons with AD cannot retrace their steps to find a misplaced item.	"Too redundant." (Lay Leader) "*Retrace* may be too difficult for someone with low literacy." (Nurse Expert)	Deleted
24. Persons with AD don't remember where they were headed.	"Redundant." (Lay Leader)	Deleted
25. Persons with AD don't remember where they are.	"Too redundant." (Lay Leader)	Deleted
26. Persons with AD say words that make no sense.	"Persons with severe Alzheimer's disease often talk without making sense." (Nurse Expert)	Unchanged, and new item added: "Persons with mild Alzheimer's disease make up new words for things."
28. Persons with AD eventually become isolated from people who care about them.	"Good question although you may want to restate and don't use the word isolated." (Lay Leader) Additional suggestions: "Persons with Alzheimer's disease should be kept away from other people." (Lay Leader) "Most people don't want to be around someone with Alzheimer's disease." (Nurse Expert)	Both suggestions added.
29. Persons with AD can't remember why they went into another room.	"This is true for anyone who is stressed." (Nurse Experts)	Deleted

Additional items suggested to sufficiently address all domains:	"Finding out early on that you have Alzheimer's disease means that there is more of a chance for treatment." (Nurse Expert/Lay Leader)	All suggestions accepted except the last item because it was outside the scope of this measure.
	"Alzheimer's and dementia are the same thing." (Lay Leader)	
	"There is nothing that can be done to decrease the chances of getting Alzheimer's disease." (Nurse Expert)	
	"People with Alzheimer's lose the ability to communicate." (Nurse Expert)	
	"Persons with severe Alzheimer's cannot tell you if they are in pain." (Nurse Expert)	
	Persons with Alzheimer's disease eventually become like strangers to people who care about them. (Nurse Expert)	
	"Persons with mild Alzheimer's disease cannot tell someone if they need to go to the bathroom." (Nurse Expert)	
	"Persons with advanced Alzheimer's disease may not talk at all." (Lay Leader)	
	"Persons with mild Alzheimer's disease cannot follow directions very well." (Nurse Expert)	
	"There is nothing a doctor can do to help someone with Alzheimer's disease." (Lay Leader)	
	"Doctors recommend that people over 65 should get their memory checked every year." (Nurse Expert)	
	"Herbs such as ginseng will help keep memory strong." (Nurse Expert)	
	"Do you think that people in your community know that there is help for persons with Alzheimer's disease?" (Lay Leader)	

Note. AD = Alzheimer's disease.

part of aging was retained." Eighty percent of the participants interviewed indicated aware-ness of the ongoing development of new interventions for AD. All subjects expressed an enthusiastic interest in being recipients of any new treatments and knowledge, supporting the inclusion of the item "Nothing can be done to decrease the chances of getting AD."

None of the participants commented on early testing or detection for AD. However, three items addressing the topic of cognitive screening were retained because increas-ing cognitive screening rates is a long-term goal of our program of research. These three questions were "Finding out earlier that you have AD may help you by starting treatment earlier," "If you are having problems with your memory you should see a provider," and "Doctors recommend that persons over 65 should get their memory checked every year."

Regarding prevention, participants often stated the importance of exercise (90%) and eating right (75%) as ways to help prevent AD. Exercise was already included in the BKAD, but nutrition was not. In light of recent findings suggesting that there may be a link between high-cholesterol and high-fat foods and AD (Carson-Smith, Nielson, Woodard, Seidenberg, & Rao, 2013), this is a consideration for the next revision of the BKAD. The interviewees did not broach the subject of taking prescribed medications, but 75% of par-ticipants mentioned taking herbs such as yellowroot, usually when they were younger. This group expressed that taking herbs may have helped to protect them from developing AD. Because this may be an important topic or behavior important to this population, the item addressing ginseng was edited to inquire about general herbs.

Of the participants interviewed during the think-aloud exercise, 100% had been or were current caregivers of persons with AD. Participants spent most of the time in conversation with the researcher describing forgetfulness, aggressiveness, wandering, and changes in personality that they had to manage when caring for their loved ones. It was apparent that this was an area of concern for the interviewees; thus, the items addressing symptoms were retained in the BKAD test. Subjects offered statements such as "It got so bad that I didn't even know who they were anymore . . . they didn't know me." The item "Persons with AD change so much that they are no longer the person they once were" was suggested by CVI experts and supported by this feedback. Other questions addressing symptoms often cited by the subjects were also listed in the "Ten Early Warning Signs of AD" (AA, 2017b) and therefore retained in the measure.

Item Reduction. Based on the CVI and cognitive interviewing results, the nurse researchers reduced the number of the preliminary BKAD test items from 39 to 20. Reasons for item deletion included that questions were not specific to AD, not important, potentially confusing or demeaning to participants, wording was not as effective as a similar item, readability level was too high, or there was a lack of a proven relationship to AD. During inspection of results, the instrument developers also realized that the correct answer could be different, depending on the stage of the disease, which was not clarified in the question. These items were revised or dropped from the revised instrument.

The next version of the BKAD (Study 2) was tested in the same county as Study 1. The revised BKAD consisted of 20 questions with a Flesh–Kincaid readability statistic of 7.2. Eleven questions related to the AD domain of symptoms, 3 questions each related to risk and detection, 2 questions related to treatment, and 1 question related to prevention. Participants received 1 point for each correct answer on the 20-item BKAD and 0 points for each incorrect answer. Items 1, 4, 6, and 17 were correct if answered "false" and there-fore received 1 point. For the remainder, the correct answer was "true." This version was piloted in a larger sample of 200 participants (Study 2) and included more in-depth validity and reliability testing.

Construct Validity

In Study 2, we administered a sociodemographic survey, the BKAD instrument, and the KAD tool by Jang et al. (2010) to 200 rural older adults in southern Appalachia. Data analysis included reliability testing using Rasch analysis (1960, 1980) as discussed by Linacre (1994, 2015) and Polit and Yang (2016). Assessment of AD knowledge was based on BKAD item and total score analysis. Factors potentially predicting knowledge level, including age, miles from a health care provider, caregiver status, gender, and years of education, were examined.

Setting. The setting was in the southern portion of Fayette County, WV, a county of 661 square miles classified as "at risk" economically in 2014 by the Appalachian Regional Commission. In 2012, the majority (98%) of the county was non-Hispanic White, 78% were high school graduates, and persons older than 65 years comprised 17.7% of the population (United States Census Bureau, 2012). Almost 19% of the population was living below the poverty level from 2008 to 2012 with an average monetary income of $18,222. This population was chosen because of its rurality and the ease of access, as the primary investigator is from WV.

Sample. To calculate an adequate sample size, we used Nunnally and Bernstein's (1994) recommendation of at least 10 subjects per item for psychometric testing. Ten percent of the projected larger sample ($N = 200$) was chosen as the number for the stability and validity samples (Sample A). Sample B was the test–retest group, and a group of South Florida health care providers served as Sample C. The sociodemographics of the three samples are available in Table 4.

Sample A. The WV public sample ($N = 200$) were persons recruited over 3 days who visited a large retail store ($n = 138$) or attended a senior citizen day center ($n = 62$) and were asked to participate in a study about knowledge of AD in exchange for a $5 gift card. Inclusion criteria for this rural public sample were 55 years or older, a resident of southern WV, English speaking, and able to answer the study questions. Licensed health care providers (registered nurses and physicians) or residents from other states were excluded from Samples A and B.

Sample B. The test–retest group was a separate sample of 20 persons attending a nearby senior citizen center who agreed to take the test at two different time points 3 weeks apart under similar conditions and settings. Inclusion criteria were the same as Sample A. Exclusion criteria were residence other than WV, not speaking English, or a licensed health care provider.

Sample C. Florida licensed health care providers ($n = 20$) from the investigators' university memory and wellness center served as the discriminant validity sample. Inclusion criteria for this Florida professional group were a licensed health care provider working with persons with dementia, English speaking, and able to answer the study questions. There was no age limit for this sample. Nonlicensed providers and staff were excluded from Sample C.

Recruitment

For the Sample A public group, persons entering a local low-cost merchandise store were invited to participate in the study from signage attached to the investigator's station (card table and chairs) located outside the store. The test–retest senior center Sample B group was recruited through signs advertising the study that were placed in the senior center. On the day of data collection, interested participants were invited to participate in the same

TABLE 4. Sociodemographics of Categorical Variables for Basic Knowledge of Alzheimer's Disease Samples A, B, C, and D

Variable	Rural Sample A n = 193		Retest Group Sample B n = 20		Clinic Group Sample C n = 20		Licensed Sample D n = 20	
	f	%	f	%	f	%	f	%
Gender								
Male	85	44	5	25	3	15	3	15
Female	108	56	15	75	17	85	17	85
Caregiver								
Yes	39	20	10	50	20	0	17	85
No	153	80	10	50	0	0	3	15
Ethnicity								
European American	18	94	19	95	16	80	14	70
African American	8	4	—	—	—	—	—	—
Afro Caribbean	—	—	—	—	2	10	2	10
Asian American	—	—	—	—	1	5	1	5
Other	4	2	1	5	1	5	3	15
Religion								
Protestant	153	85	16	80	15	75	14	66
Catholic	6	3	1	5	0	0	4	20
Muslim	—	—	—	—	1	5	—	—
Other	22	11	3	15	4	20	2	10
Marital Status								
Single	29	15	5	25	1	5	1	5
Married	90	47	2	17	15	75	13	65
Widowed	55	29	11	55	1	5	2	10
Separated	1	0	0	0	1	5	0	0
Divorced	18	9	2	10	2	10	4	20

manner as Sample A, with the exception that the investigator's table was in the dining room. The same procedure was followed for Sample C, which was the licensed health care providers who worked at a large memory and wellness center.

Flyers explaining the purpose, brief time commitment, and interview style of the study were provided to all three samples prior to obtaining informed consent. To determine study eligibility, those indicating willingness to participate were asked place of residence, age, and if they were a health care provider. After informed consent, face-to-face interviews were conducted individually in either a private room or behind a portable privacy curtain using clipboards and chairs, and the participants received a $5 gift card to the store as a thank you for completing the tests.

Definition of Terms and Research Variables

The following terms were defined conceptually and operationally for purposes of this study: *Alzheimer's disease*, *rural setting*, *rural residency of West Virginia*, *knowledge of Alzheimer's disease*, *Appalachia*, and *older adult*. Sociodemographic variables are also defined.

Alzheimer's Disease. The traditional conceptual definition of AD has been the presence of clinical syndromes combined with amyloid plaques and neurofibrillary tangles found in the cerebral cortex on microscopic upon postmortem examination (Hyman et al., 2012). The National Institutes of Health Alzheimer's Disease Education and Referral (ADEAR) Center also defines AD as an irreversible, progressive brain disease that slowly destroys memory and thinking skills and, eventually, the ability to carry out the simplest tasks of daily living. In this study, the term *Alzheimer's disease* includes related dementias.

Rural Setting. Following the recommendations of the National Archives and Records division branch of the United States Commerce Department for the 2010 census, the United States Census Bureau (2010) has defined *rural* as that which encompasses all territory, population, and housing not included within an *urban area*, which is defined as population centers of 50,000 or more. For this study, rural settings were defined as settlements with 25,000 or less inhabitants.

Rural Residency of West Virginia. Based on the research by Rosswurm, Dent, Armstrong-Persily, Woodburn, and Davis (1996) and for purposes of this study, rural residents of WV were defined as residents living within zip code areas of counties identified as rural or if residents who live in mixed urban/rural areas perceived themselves as being rural.

Knowledge of Alzheimer's Disease. For purposes of this study, AD knowledge was defined by the score achieved on the BKAD scale.

Older Adult. For purposes of this study, older adult was defined as 50 years or older.

Demographic Research Variables

Proximity to a health care provider was defined as number of miles from the subject residence to a primary care provider, site, health care clinic, or hospital. This variable was explored as rural areas are often associated with long travel distances to a provider (Buzza et al., 2011). Experience with AD was defined as caring for a person with AD for a minimum of 4 hr per week. Education was defined as number of years of formal education. Age was number of years lived. Ethnicity was defined as ethnic background (e.g., Hispanic, non-Hispanic). Religion was defined as person's self-reported religious affiliation. This was listed as Protestant (Christian, Baptist, Methodist, Lutheran, Other Protestant), Catholic, Jewish, Muslim, Buddhist, or Other. Marital status was defined by self-identified relationship (e.g., single, married, widowed, separated, or divorced). Ethnic background was defined by self-identification of ethnicity. Based on feedback and findings from Study 1, the following categories were used: American, African American, Afro-Caribbean, Asian American, Hispanic American, and Other. Occupation was defined by self-reported employment or service that participant primarily was engaged in during working years. Birthplace was defined by state in which the participant was born.

RESULTS

The first objective of this study was to estimate the reliability and validity of a new instrument to test knowledge about AD among rural older adults in Appalachia. Tests for internal consistency and stability centered on Rasch modeling (1960, 1980) and test–retest.

Rasch Analysis

Tests for internal consistency were lower than the .70 recommended for new instruments (Nunnally & Bernstein, 1994) and the Cronbach's alpha of the item total scores were also low, ranging from .45 to .50 (Table 5). Tests using possible combinations of subscales achieved similar results, indicating one construct (AD knowledge). Rasch modeling was the method chosen, as "using item response theory (IRT) methods (assuming model assumptions have been met), researchers can analyze data from an existing scale and more carefully evaluate the performance of each item" (Polit & Yang, 2016, p. 89). The following assumptions were met: unidimensionality, local independence, monotonicity, and invariance (Polit & Yang, 2016, p. 74). Specifically, AD knowledge was the unidimensional construct addressed by the five domains, the responses were not dependent on each other, the probability of responding to a given item increased monotonically with increased levels of the trait, and items were calibrated with a sufficient sample from a heterogenous population (Polit & Yang, 2016, p. 74). The item reliability of .96 in the model indicated that the sample size was sufficient to locate the items on the latent variable (Linacre, 1994, 2015). The mean outfit standard of .001 for persons and -0.1 for items are expected values that also supported that the data fit the model. The outfit Z standard deviation, .001 for person and .1 for items, were also within the expected value of 1 (Linacre, 2015). Outliers (1.6% of the participants or three people) were removed during the analysis if the outfit Z standard deviation was greater than 1.3 (Smith, Schumacker, & Bush, 1998). The person to raw score measure had a correlation of .88 with a Cronbach's alpha of .5. These results also indicate a lower level of reliability for this instrument, where .30 is poor, .50 is weak, and .70 is acceptable for a new instrument.

Rasch (1960, 1980) goes beyond indices of item reliability by considering the individual's rather than the population's distribution of ability. Specifically, Rasch modeling analyzes individual test items relative to how the respondent answers other questions of similar difficulty level instead of just the total score by measuring the person separation index and person reliability (Waltz et al., 2010). Person separation is used to classify subjects based on high and low scores, and person reliability is used to show variability in subjects' ability (Waltz et al., 2010). The person reliability index can range from 0.0 to 10.0, and the person reliability score in this study was .38 (Table 6). The person separation index, which typically ranges from 1.0 to 3.0 (Polit & Yang, 2016), in this study was .78. A low person separation of less than 2 with person reliability less than .8 with a relevant person sample that was achieved in this study (see Figure 1) implied that the instrument may not be sensitive enough to distinguish between high and low performers.

This finding that greater variety in the difficulty of the test items was needed was also illustrated in the WINSTEPS Construct KeyMap of Reliability (Figure 2). In the KeyMap, items are ordered from easiest, represented by the bottom numbers, to the most difficult (top numbers). A vertical item hierarchy is visually helpful in understanding the results. The real benefit of a WINSTEPS Construct KeyMap is that the "category responses represent the item-person response matrix once the responses are converted to equal-interval Rasch measures. This transformation elevates the interpretation from describing the current few observed averages to predicting future probabilistic responses in equal intervals" (Bond & Fox, 2015, p. 133). The scores in this study were grouped narrowly from 0 to 5 in ability level rather than being more widely distributed. Many of the BKAD test items performed at a lower level of difficulty. There was insufficient

TABLE 5. Basic Knowledge of Alzheimer's Disease (BKAD) Items Deleted if Indices $p \leq .20$ in All Tests for Item Discrimination, Difficulty, and Item-to-Total Correlations

Items	BKAD Items Deleted Based on Item and Point Biserial Discriminations	Item Discrimination; Items Scoring @ .20 or Lower Deleted	Point-Biserial Discrimination Index; Items Scoring .20 or Lower Deleted	Cronbach's Alpha If Item Deleted	Item to Total Correlation
AD is a normal part of aging		.46	.27	.46	.15
Staying active helps		.42	.28	.48	.08
Are not crazy	✓	.20	.19	.43	.37
Nothing can be done to decrease chances		.49	.28	.46	.15
Medicine may slow down onset of AD	✓	.21	.16	.48	.05
Find it harder to remember things	✓	.09	.14	.47	.17
Chance of getting AD greater if parent has it		.53	.26	.47	.15
May become lost in familiar places	✓	.13	.16	.46	.19
May accuse others of stealing missing items		.28	.24	.45	.24
Losing car keys does NOT mean getting disease		.30	.22	.45	.21
Finding out early may help by starting treatment		.30	.31	.44	.34
May not understand what is being said to them	✓	.16	.15	.47	.10
In later stages may take things that don't belong		.27	.22	.45	.21
May forget words when talking		.38	.32	.44	.34
AD is a type of dementia	✓	.21	.16	.49	−.01
All will go through a violent stage		.66	.31	.46	.18
Eventually change so much nothing is left		.47	.25	.48	.1
Problems with memory need to see provider		.58	.32	.47	.11
Herbs will not improve memory		.29	.27	.48	.12
Drs. recommend over 65 get memory checked		.47	.22	.49	.04

Note. AD = Alzheimer's Disease. Overall $\alpha = .48$.

```
                TOTAL                           MODEL       INFIT         OUTFIT
                SCORE       COUNT     MEASURE    ERROR    MNSQ   ZSTD    MNSQ   ZSTD

    MEAN        15.6        19.9       -3.85      .70      .98    .1      .91    .0
    S.D.         2.3          .9         .99      .23      .35    .9      .67    .8
    MAX.        20.0        20.0         .14     2.84     2.67   3.5     5.21   2.7
    MIN.         8.0        13.0       -6.34      .52      .01  -2.0      .00  -1.5

    REAL RMSE     .78 TRUE SD    .61  SEPARATION   .78  PERSON RELIABILITY  .38
    MODEL RMSE    .74 TRUE SD    .65  SEPARATION   .88  PERSON RELIABILITY  .44
    S.E. OF PERSON MEAN = .07

PERSON RAW SCORE-TO-MEASURE CORRELATION = .88
CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .50

        SUMMARY OF 20 MEASURED ITEM

                TOTAL                           MODEL       INFIT         OUTFIT
                SCORE       COUNT     MEASURE    ERROR    MNSQ   ZSTD    MNSQ   ZSTD

    MEAN       150.8       191.9         .00      .24      .99    .2      .91   -.1
    S.D.        37.3         1.4        1.32      .08      .08    .6      .26    .9
    MAX.       188.0       193.0        2.93      .44     1.13   2.1     1.34   1.5
    MIN.        54.0       190.0       -2.12      .16      .84   -.7      .41  -1.8

    REAL RMSE     .25 TRUE SD   1.30  SEPARATION  5.15  ITEM   RELIABILITY  .96
    MODEL RMSE    .25 TRUE SD   1.30  SEPARATION  5.19  ITEM   RELIABILITY  .96
    S.E. OF ITEM MEAN = .30

ITEM RAW SCORE-TO-MEASURE CORRELATION = -.97
3839 DATA POINTS. LOG-LIKELIHOOD CHI-SQUARE: 2872.33 with 3626 d.f. p=1.0000
Global Root-Mean-Square Residual (excluding extreme scores): .3439
UMEAN=.0000 USCALE=1.0000
```

Figure 1. Rasch Modeling Summary and Separation Table.

dispersion of the participants' ability in the sample. The person to raw score measure in the Rasch analysis had a correlation of .88 with an alpha of .5. These results also indicate a lower level of reliability for this instrument, as a score above .7 for a new instrument is recommended (Nunnally & Bernstein, 1994). Rasch (1960, 1980) modeling equations with resulting indices of difficulty and discrimination point biserial indices were also calculated (see Figure 1).

Difficulty Index

Guided by IRT from the Rasch (Bond & Fox, 2015) analysis, and using the same halves of the sample as determined for the discrimination index, a difficulty index represented by p was calculated to show the percentage of people who answered each item correctly. If a greater percentage of persons who were in the higher scoring group actually scored low on an item, then the item was too difficult. If a higher percentage (25%) of both groups scored very low or very high (incorrectly or correctly), the item was considered for deletion from the test as it failed to differentiate between subjects based on their knowledge (Carpenter et al., 2009, p. 244). The difficulty index for each item appears in Table 5. Pedhazur and Schemeilkin (1991) recommend retaining items whose difficulty index is higher than .20.

Discrimination Index

To evaluate whether any of the individual items on the BKAD test discriminated between persons with higher or lower AD knowledge, a discrimination index was calculated (Carpenter et al., 2009). Groups were determined by dividing the scores as seen in Table 5 into the lower third and upper two thirds. Persons scoring between 15 and 20

```
TABLE 2.2 BKAD 2013_08_01.sav                    ZOU916WS.TXT  Sep 10 14:29 2013
INPUT: 193 PERSON  20 ITEM  REPORTED: 193 PERSON  20 ITEM  3 CATS WINSTEPS 3.80.0

EXPECTED SCORE: MEAN  (Rasch-score-point threshold, ":" indicates Rasch-half-point threshold) (ILLUSTRATED BY AN OBSERVED CATEGORY)
-9   -7    -5    -3    -1    1    3    5    7    9   11
+----+-----+-----+-----+-----+----+----+----+----+----+    NUM    ITEM
0              0    :                 1                :  2   2    17   BKAD17
|
|
0           0   :                1              :  2     2    20   BKAD20
0           0  :                 1              :  2     2    19   BKAD19
|
|
0          0   :              1               :  2      2     7   BKAD7
0         0  :               1               :  2       2    16   BKAD16
|
|
0        0  :             1              :  2           2     4   BKAD4
0       0  :              1             :    2          2     1   BKAD1
0       0  :              1             :  2            2    18   BKAD18
|
0      0   :            1             :  2              2    15   BKAD15
0      0  :             1             :  2              2     2   BKAD2
|
0     0  :            1             :  2                2     5   BKAD5
0     0  :            1             :  2                2    10   BKAD10
|
0    0  :           1            :  2                   2    13   BKAD13
0    0 :            1            :  2                   2     9   BKAD9
0  0   :          1           :  2                     2     3   BKAD3
0  0   :          1           :  2                     2    12   BKAD12
|
0  0  :           1          :  2                      2    14   BKAD14
0  0  :           1          :  2                      2    11   BKAD11
|
0 0  :         1               :   2                   2     8   BKAD8
|
0   :        1            :  2                         2     6   BKAD6
+----+-----+-----+-----+-----+----+----+----+----+----+    NUM    ITEM
-9   -7    -5    -3    -1    1    3    5    7    9   11

          1 134 42
         14524603 51  9    1 2                          PERSON
          T S  M  S T
         0 10 30 80 90    99                            PERCENTILE
```
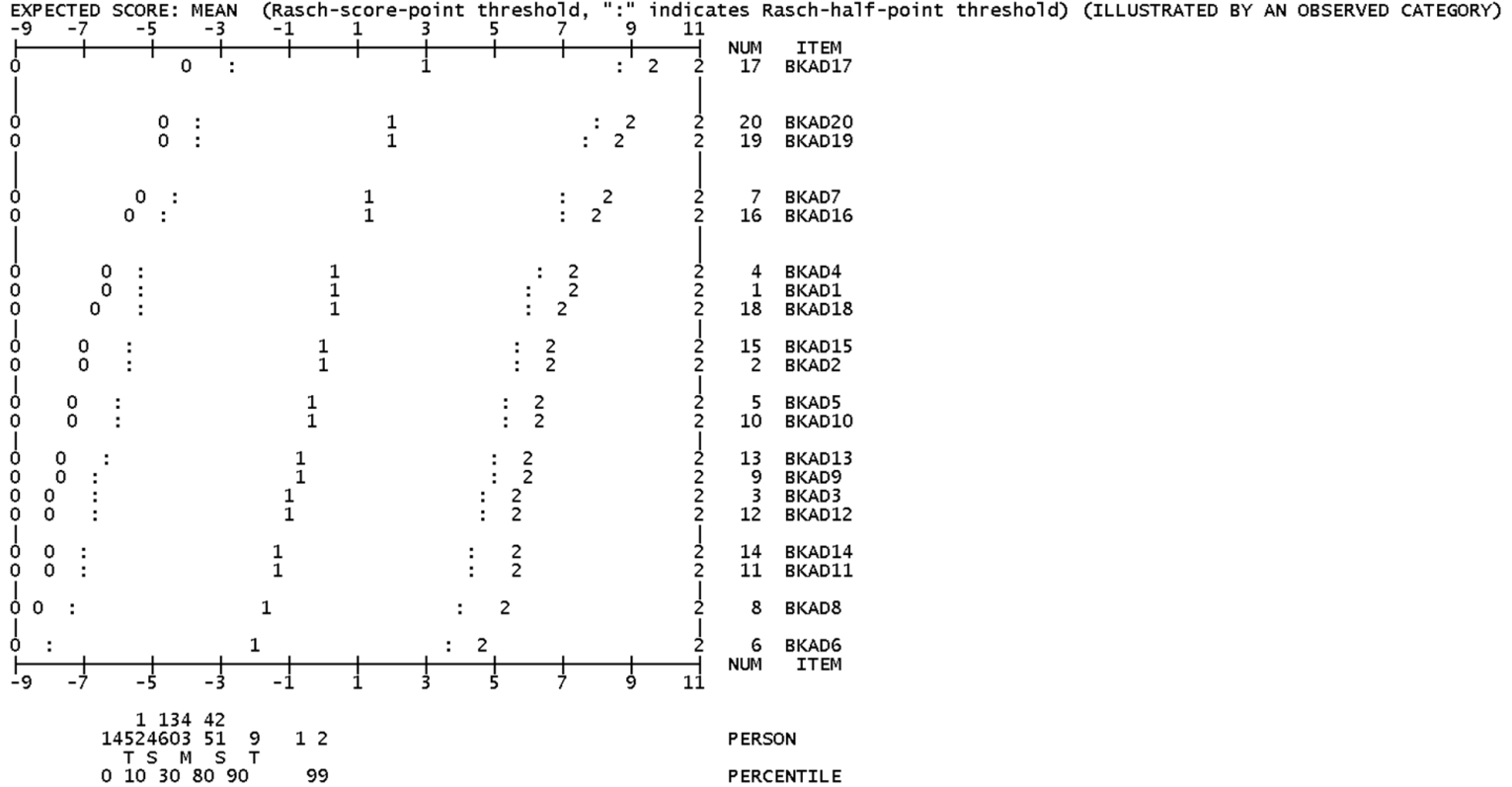
Figure 2. Construct keymap of item difficulty and sample dispersion.

on the BKAD test were placed in the higher knowledge group ($n = 119$) that comprised approximately 65% of the sample, and persons scoring equal to or lower than 15 became the lower knowledge group ($n = 74$). Next, as recommended by Carpenter et al. (2009), the percentage of participants in each group who answered each item correctly was calculated, and the proportion of respondents who answered the item incorrectly was subtracted from the proportion of respondents who answered correctly to determine each item's discrimination index.

Test–Retest

The test–retest group consisted of senior citizen center attendees ($n = 20$) from the same geographical area. The BKAD was to the same attendees 4 weeks apart. The total mean score was 15.5 ($SD = 2.01$) at Time 1 and 16.0 ($SD = 1.59$) at Time 2 with no significant difference between Time 1 and Time 2, $t(-.96) = 19$, $p = -.349$.

Tests for Validity

Examining face, content, and construct validity is important step in establishing a quality measure (Polit & Yang, 2016). Face validity was explored with the local clinic nurses during the mini-pilot and with residents during think-aloud exercise. Content validity was analyzed using a CVI and nurse expert review during the development that was discussed earlier in the section regarding test development. Construct validity was examined through tests for concurrent and discriminate validity and principal components analysis (PCA). The construct validity testing is discussed in the following text.

Concurrent Validity. Concurrent validity was evaluated in this study by comparing the results of the BKAD to a KAD scale by Jang et al. (2010). The 10-item true/false knowledge KAD, first written in the Korean language and designed for use among Korean Americans, was the only recently developed measure found by this researcher that is designed to investigate AD knowledge among non-health care professional older adults. Permission was obtained from the authors to use the KAD during the pilot studies for concurrent validity. Questions on the KAD concentrated more on myths of AD such as "Alzheimer's disease can be diagnosed with a blood test," "Alzheimer's disease only occurs in the elderly population," and "Alzheimer's disease could be contagious." However, four of the five items that were very similar between the KAD and BKAD correlated significantly ($p = .001$) and one correlated with a significance of $p = .01$, demonstrating some concurrent validity.

The Pearson correlation coefficient comparing total mean scores of the KAD and BKAD was weak: $r = .37$ ($p < .001$). This result suggests that concepts measured in the BKAD test, although different from the KAD, were minimally related. The KAD was used with urban and rural Korean American family members, and the BKAD was used with a rural Appalachian group, most of whom were not relatives of persons with AD.

Discriminant Validity. To test for discriminant validity, the BKAD was administered to 20 licensed providers in an urban South Florida area (Study 3). This sample was selected because of the contrast in the setting (urban with more health care access), education level ($M = 15.1$, $SD = 2.39$), age ($M = 42.4$ years, $SD = 8$), and experience in caring for patients with AD ($n = 17$ with more than 4 years), which is similar to the population for which the most widely used AD knowledge measures such as Carpenter et al. (2009) were designed. This sample was recruited by e-mail through contacts provided to study investigators. All but one Sample C participant was a college graduate and five were health

care professionals with post-college graduate education. This discriminate group included nine nurses, two psychologists, two social workers, one physical therapist, and six clinical, college-educated staff. BKAD total scores were compared between this sample and the WV public group. In comparison, the mean BKAD score of the South Florida professional group was 18.4 (*SD* = 1.43), whereas the mean BKAD score in the WV public group was 11.85 (*SD* = 1.89). Analysis of variance calculations demonstrated a significant difference between these two samples, $F(2, 226) = 170.51$, $p = .001$.

Principal Components Analysis. Both an exploratory factor analysis (EFA) and a PCA were considered for evaluating BKAD construct validity. First, to test the adequacy of Sample A, the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were calculated. The KMO sampling adequacy was moderately low, and all KMO values for individual items were equal to .57, which is above the recommended minimum of .5 (Field, 2013). Bartlett's test of sphericity ($p < .000$) demonstrated homoscedasticity or equal variance across groups, indicating that the number of items were sufficient for analysis of the test structure (Field, 2013). Next, an analysis was run on the 20 BKAD items to ascertain eigenvalues greater than 1 for components in the data. Seven items loaded across more than one component, suggesting that there may be loosely defined domains, which was also seen in the item analysis and subscale query. PCA was selected as recommended by Waltz et al. (2010) "for a test developer or researcher seeking to support the construct validity of a scale" (p. 170) as the "constraints of EFA would be inappropriate" (p. 170). PCA is also supported for the following reasons (Neil, 2008): PCA is helpful when (a) "leveling off" the eigenvalues after three or four factors occurs, (b) not all of the factors load sufficiently, and (c) there is difficulty in interpreting a factor.

Orthogonal varimax converged in eight iterations and yielded five components. The BKAD items with their loadings are shown in Table 6. The point of separation between the most and least important components based on contribution to the total variance, known as the *elbow point* (Tappen, 2016), was evident between Components 4 and 5 in the scree plot shown in Figure 3. The unrotated component analysis explained 49% of the variance within items.

Item loadings >.30 (Nunnally & Bernstein, 1994; Waltz et al., 2010) were considered, with analysis revealing that loadings on the first through fifth components demonstrated acceptable alignment with the construct of the study, AD knowledge. The first component was labeled *Symptoms* as the item loadings included (people with AD) "In later stages may take things that don't belong to them" (.64), "May accuse others of stealing missing items" (.40), and "Having problems with memory . . ." (.61). The second component was labeled *Detection* with items such as "Losing the car keys does not mean you are getting AD" (.5) and "Alzheimer's is a type of dementia" (.49). The third component was labeled *Risk* as items that loaded included "AD is normal for aging (.63)," "Nothing can be done to decrease the risk (.4)," and "Starting treatment earlier may help to decrease chances (.70)." The fourth component labeled *Treatment* component loadings showed that treatment with either medications or herbs (−.31 and −.32, respectively) was negatively correlated with the two mood questions, indicating that persons who believed that personality changes such as aggressiveness or loss of self were inevitable did not believe that medicines or herbs could help. The fifth component was labeled *Prevention* as loaded items included "Staying active helps" (.62), "Nothing can be done to decrease the chances of getting AD" (−.34), "Herbs will not improve memory" (.37), and "Doctors recommend getting memory checked annually after age 65" (.67).

TABLE 6. Principal Components Analysis: Rotated Components Matrix of 20 Basic Knowledge of Alzheimer's Disease Items

Variables
Normal for aging
Staying active helps.
Not crazy
Nothing can be done to decrease chance.
Medicine to slow down
Harder to remember things
Chance greater if parent has it
May become lost in familiar places
May accuse others of stealing missing items
Losing car keys does NOT mean getting disease.
Finding out early may help you by starting treatment.
May not understand what is being said to them
In later stages may take things that don't belong to them
May forget words when talking
Is a type of dementia
All will go through a violent stage.
Eventually change so much nothing is left
Problems with memory be seen by provider.
Herbs will not improve memory.
Doctors recommend over 65 get memory checked.
Percentage variance

Note. Extraction method: principal component analysis. Rotation method: varimax with Kaiser normalization. Rotation converged in eight iterations.

To further assess the scale for validity, null and restricted multiple linear regression models were performed to test whether the set of sociodemographic predictor variables (age, education, gender, AD caregiver status, and proximity to a health care provider) accounted for a significant proportion of variance in BKAD scores (Newman & Newman, 2012; Pedhazur & Schmeilkin, 1991). Independent variables included age, gender, years of education, proximity to a health care provider, and experience as a caregiver for someone with AD. These variables did significantly predict the total BKAD score, $R^2 = .05$, $F(4,187) = 2.65$, and $p = .04$. However, only years of education accounted for a significant proportion of unique variance in predicting total BKAD ($t = 2.14$, $p = .03$). The demographic variable age was removed from this analysis because of high multicollinearity with other predictor variables (condition index $= 22.37$). According to Field (2013), a condition index greater than 15 indicated high collinearity. All of the other predictor variables had a condition index less than 8.71.
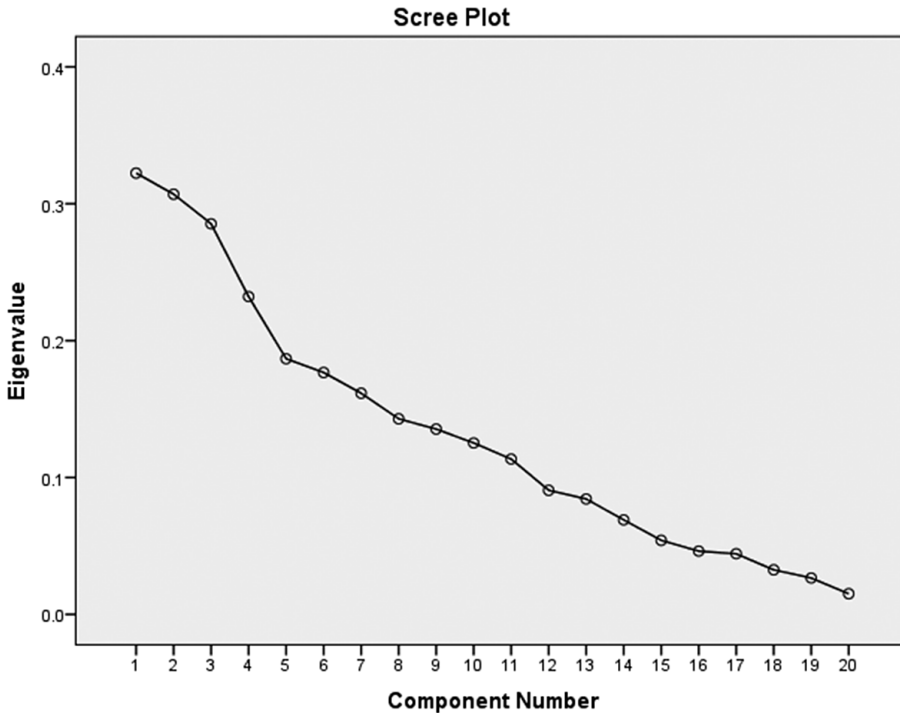
Figure 2. Scree plot indicating elbow point of component separation.

Basic Alzheimer's Disease Knowledge Scores

The second objective of this research was to describe the AD knowledge levels of a rural older adult group in Appalachia (Sample A, *n* = 200). Results calculated using SPSS Version 21.0 for Windows (Field, 2013) were compared with the test–retest group (Sample B, *n* = 20) and the discriminate group (Sample C, *n* = 20). Potential predictors of knowledge in the participant group were also explored. As expected, there were significant differences in education: Sample A (*M* = 11.4, *SD* = 3), and Sample C (*M* = 15.1, *S* = 2.39) comparisons yielded a *t*(8) = 3.79, *p* = .005. There were also significant differences in age: Sample A (*M* = 69.4, *SD* = 10.5), and Sample C (*M* = 42.4, *SD* = 8) comparisons produced a *t*-test result of *t*(7) = 2.84, *p* = .001.

The frequency and percentage of participant responses to each item were calculated to evaluate potential knowledge gaps. Most of the lay participants scored below 80% on questions targeting screening, risk of developing AD, or progression of the disease. "If you have problems with your memory, you should be seen by a health care provider" at 77.6% and "Doctors recommend that people over 65 should get their memory checked every year" at 41.8% were related to screening. "Nothing can be done to decrease the chances of getting AD" at 76%, "The chance of developing AD is greater if a parent had it" at 58.7%, and "AD is normal for aging" at 76.5% were related to risk of developing the disease. Two questions concerned progression of the disease: "All persons with AD eventually become violent" at 61.2% and "Persons with AD eventually change so much nothing is left of the person they once were" at 27.6%.

The greatest gaps in knowledge among the licensed and experienced AD provider staff discriminant group (Sample C) were surprisingly found in these items: "Staying active may help to prevent AD" (75% correct), "Persons with dementia change so much that there is nothing left of the person they once were" (65%), "All persons with AD eventually go through a violent stage" (85%), and "Doctors recommend that persons over 65 get their memory checked" (50%). The providers scored 95%–100% correct in the other items.

The public group's scores (Sample A) ranged from 7 to 17 items or 35%–85% correct with a mean of 11.85 ($SD = 1.89$), which is 59% correct. The licensed health care providers scored much better. They answered most items correctly, with a mean of 18.4 ($SD = 1.43$) or 92%. As expected, the two groups were significantly different, $F(2, 226) = 170.51$, $p = .001$. Post hoc comparisons showed that Sample A (public) scored lower than the Sample C (providers), and providers scored significantly higher than either of the groups with less education: the public and Sample B (retest group). The results of the comparisons between Samples A, B, and C using post hoc Bonferroni corrections were significant, $F(2, 226) = 170.51$, $p = .001$.

Factors that may predict AD knowledge in a sample of rural older adults to aid in developing future educational innovations were also examined. These factors included age, education, gender, AD caregiver status, and proximity to a health care provider. Education was the unique predictor, as expected. Research participants with higher levels of education answered the test items correctly more often than those with lower education levels.

DISCUSSION

The overall purpose of this research was to develop a socially, culturally, and educationally sensitive measure that is appropriate for use with older, rural, underserved populations. Implications for future work in nursing practice, research, and policy follow highlighted discussion points related to the study's purpose that are organized by the three main study objectives.

Objective 1

The first objective was to estimate the reliability and validity of a new instrument to test knowledge about AD among rural older adults in Appalachia. The CVI reviewer comments and cognitive interview results from Study 1 were reviewed and changes were incorporated prior to piloting the measure in Study 2. Coming to know this population through discussions using the think-aloud inquiry added valuable information about which items were most relevant. Analyses indicated that the BKAD measure has acceptable content, concurrent, and discriminate validity. Tests to examine construct validity demonstrated that the five knowledge domains (risk, prevention, symptoms, detection, and treatment) were supported in the PCA.

However, there was an insufficient number of challenging items as evidenced by difficulty and discrimination indices (see Table 5). Six items discriminated poorly between persons of higher or lower knowledge levels. Results of Rasch analysis confirmed these findings, with low person separation scores of less than 2 (see Figures 1 and 2). Items were marked if their discrimination and difficulty point biserial indices were .20 or below (see Table 5). These items are "Persons with AD find it harder to remember things," "Persons with AD may become lost in familiar places," "Persons with AD may not understand what

is being said to them," "People with AD are not crazy," "There may be medication to slow it down," and "Alzheimer's is a type of dementia." These items will be reviewed for deletion or editing by the nurse experts prior to inclusion in the next version of the BKAD.

Objective 2

The second objective was to describe the AD knowledge levels of rural older adults in Appalachia. The lay population knew more about the symptoms of the disease, the potential benefit of exercise, increased AD risk associated with diabetes or cardiovascular disease, and less about the need for early detection and treatment. The provider group knew less about the benefits of exercise or need for detection. These results hint that assessment of AD knowledge in both lay and provider populations would be helpful prior to initiating any programs to increase awareness and screening.

CONCLUSION AND NURSING IMPLICATIONS

Previous researchers have demonstrated that older adults who perceived the benefits of dementia diagnosis demonstrated more willingness to be cognitively screened, regardless of whether symptoms were present (Galvin et al., 2009). In every study reviewed here, the authors indicated the need for widespread surveys regarding AD knowledge and awareness among ethnic minorities, noncaregiving relatives, or persons of lower socioeconomic status. A measure of basic AD knowledge that would be a good fit for use by nurse researchers and other health science investigators in underserved populations is needed.

The AA (2017a) mission is to "eliminate Alzheimer's disease through the advancement of research; to provide and enhance care and support for all affected; and to reduce the risk of dementia through the promotion of brain health." The AA has brought increased awareness regarding AD signs and symptoms to persons who have access to computers, regional educational efforts, or local distribution of written pamphlets. This macro level of education until recently had given minimal attention to risk, detection, treatment, and healthy lifestyles to delay onset, but computer and reading literacy is required. The AA has not promoted a measure to determine the effectiveness of their educational efforts among the public or varied cultural groups. This study was the first attempt at piloting a new instrument to determine knowledge gaps about AD symptoms, risk, detection, treatment, and prevention in rural populations.

Implications for Nursing Practice

Implications for nursing practice include the need to educate providers and the lay public about AD risk and of the benefits of earlier detection and treatment. Although the AA (2017b) has a campaign, "The Ten Warning Signs of Alzheimer's Disease," it focuses largely on symptoms. The BKAD can be a useful instrument for determining knowledge gaps and designing education programs to increase perception of risk and benefits to early diagnosis. Increased perception of risk has been shown to motivate persons to be screened in rural studies targeting cancer and diabetes (Della, 2011; Della et al., 2013; Hatcher et al., 2011). Because rural residents differ from urban residents and these differences result in health disparities, planning for programs to improve AD knowledge must be tailored to rural populations. Community health nurses and nurses caring for underserved

populations are well-positioned to investigate knowledge gaps and provide education to increase knowledge about AD symptoms, risk, and earlier detection and treatment (Wiese & Williams, 2015).

Implications for Future Nursing Research

The AA Strategic Plan FY 2015–2017 (2017a) recognized the need to include diverse populations in clinical research. This study was limited to one geographic area, and therefore, the sample may not be representative of all residents of Appalachia or all rural residents. Current knowledge levels among different rural or ethnically diverse populations could be significantly different. For example, WV has a statewide initiative to increase awareness of AD, but this may be different than other rural regions, for example, rural Whites in Montana or ethnically diverse residents of southern Texas and Florida.

Administration of this instrument by nurses caring for ethnically diverse lay populations, particularly rural or underserved, can help to identify gaps in knowledge to inform AD education programs. This could be particularly important in cultures where there is an increased AD incidence, such as African Americans, who face 2.5 times the risk of AD, and Hispanic Americans 1.8 times (AA, 2017a; González et al., 2016).

Understanding the relationship between AD knowledge and health literacy would be important. Future study could include an assessment of reading level prior to test administration.

Implications for nursing research also involve additional refinement of the BKAD by editing and validating items. The remaining steps recommended by Polit and Yang (2016) of undertaking further testing to strengthen the revised BKAD through further reliability and validity testing and publishing the results have been planned. These results will be incorporated into designs for future educational endeavors in the rural population.

Nursing Implications Related to Policy

Implications for nurses to effect changes in policy include supporting private and public funding of programs to improve knowledge about AD beyond recognition of symptoms. Research funding focusing on finding the cure for AD is of critical importance. However, additional funding is needed that will lead to early identification of those who need treatment. Increasing awareness of the risk for AD and the benefits of screening may encourage the public to become more interested in protecting their own brain health. The BKAD instrument is a first step toward meeting this gap and is relevant in light of the National Alzheimer's Project Act's (Khachaturian, Khachaturian, & Thies, 2012) Objective 3 of improving early diagnosis and coordination of care of AD.

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Correspondence regarding this article should be directed to Lisa Kirk Wiese, PhD, RN, APHN-BC, CNE, C. E. Lynn College of Nursing, Florida Atlantic University, 777 Glades Road, Mail Code 84, Boca Raton, FL 33431. E-mail: lwiese@fau.edu